COMPLIANCE TESTING OF

Qualtron

EMIDS
SURVEILLANCE TRANSMITER

Test Report 90160

Tests performed during March, April, and May 1999

INDEX

DESCRIPTION OF MEASUREMENT FACILITIES

Site on File With the FCC

ID Number: 31040/SIT

" The site referenced above has been found to comply with the test site criteria found in ANSI C63.4-1992 and 47CFR Section 2.948."

Prepared/ tested &

Approved By:

02 June, 1999

Kenneth L. Boston, EMC Lab Manager *Date*
PE #31926
Registered Professional Engineer
(State of Wisconsin)

1.1 SUMMARY OF TEST REPORT

MANUFACTURER:	QUAL-TRON, Inc
MODEL:	EMIDS MMCT
SERIAL:	pre-production
DESCRIPTION:	ELECTRONIC SURVEILLANCE DEVICE
FREQUENCY RANGE:	TRANSMITTER; 154 MHz TO 156 MHz: upon any one of 42 Assigned channels

The Qual-tron EMIDS MMCT surveillance transmitter was found to **meet** the requirements for a certified radio transmitter in the public mobile service. The pertinent sections of Part 2.1033 and part 90 were inspected and the EMIDS product was found to be in compliance with those sections.

The device tested is designed to be used by State and Local police departments for the purpose of surveillance of criminal activity. The transmitter is "tripped" by one of any number of sensors, such as an infrared beam or seismic transducer. Upon being tripped, the unit emits a very short coded transmission, which is monitored by a nearby receiver, logging the number and location of "hits". These transmitters are supplied to the purchasing agencies, capable of transmitting on the appropriate public service channels, at a power level of 1 watt. They are typically set to operate on a public service channel assigned by the national frequency coordinator to that user, and operated in a system where the monitoring point would be located nearby to the area being surveilled.

1.2 INTRODUCTION

During March, April, and May of 1999, a series of Radiated Emissions tests were performed on a sample model of the A.I.D. Surveillance transmitter. These tests were performed using the test procedures outlined in ANSI/TIA/EIA 603-1-1998 for a low power transmitter in the Public Radio service; as called for in section 2.1033 for a type accepted device, and in accordance with the limits set forth in FCC Part 90.210. Tests of conducted emissions were also performed in order to verify compliance with the limits set forth in part 90.210 and called out in section 2.1033 for a type accepted device. All radiated and conducted emission tests were performed by Kenneth L. Boston PE, of L. S. Compliance, Inc.

1.3 PURPOSE

The above mentioned tests were performed in order to determine the compliance of the test sample with limits contained in various provisions of Title 47 CFR, including:

90.203	2.1046	2.1053
90.210	2.1049	2.1055
2.1047	2.1051	

All radiated emissions tests were performed to measure the emissions in the frequency bands described by the above sections, and to determine whether said emissions are below the limits established by the above sections. These tests were performed in accordance with the procedure described in the Telecommunications Industry Association publication, TIA/EIA-603 , February 1993, and the addendum, March 1998. General radiated measurement techniques found in ANSI C63.4 were also utilized. Another document used as reference for the EMI receiver specification was the International Special Committee on Radio Interference (CISPR) number 16-1 (1993).

1.4 RADIATED EMISSIONS TEST SETUP

The test sample was operated within the 3 meter Semi-Anechoic, FCC listed chamber located at L.S. Compliance in Cedarburg, WI. The sample was placed on an 80cm high wooden table, which was centered on the flush-mounted 2m diameter metal turntable. The test sample was operated on a 9 volt regulator connected to a 12 volt battery, and an appropriate passive antenna, 50 ohm dummy load, was connected to the antenna terminals. The EMIDS occupies several small PC boards which mount into an olive green (military) plastic case, which is oriented flat on the ground during actual operation. Only this orientation was used during the tests, as the unit will power down if set at any other orientation. The test sample was configured to run in a continuous transmit mode during the radiated measurements. This continuous transmit was enabled via a special connectorized serial port on the EMIDS, accessed via a cable to a communication port on a laptop computer running Hyperterminal. The test sample was set to operate on one of two of its characteristic frequencies within the Private Land Mobile frequency assignment (Public safety radio pool): one at the low end of the band (154 MHz), one near the top of the band (155 MHz).Please refer to Section 1.15 for pictures of the test setup.

1.5 RADIATED EMISSION TEST PROCEDURE

The fundamental and spurious (harmonic) emissions of the transmitter were tested for compliance to Title 47 CFR, FCC Part90.210 limits for transmitters in the Private Land Mobile services, and were also compared with the general limits laid out in Part 15.209. For the calculations used to determine the limits applicable for the test sample, refer to Appendix A. These limits are expressed in decibels below carrier level. (-dBc) The samples were tested from the lowest frequency generated by the transmitter (without going below 9 kHz) to the 10th harmonic of the fundamental frequency generated by the device. The limits described in part 15.209 were also consulted for observation and measurement of spurious signals. The samples were placed on a nonconductive (wooden) pedestal in the 3 Meter chamber and the antenna mast was placed such that the antenna was 3m from the test object. A biconical antenna was used to measure emissions from 30 to 200 MHz, a log periodic was used to measure emissions from 200 to 1000 MHz, and a double ridged waveguide horn was used to measure emissions above 1 GHz. The test object was set to operate in continuous transmit, and the resultant signals were maximized by rotating the turntable 360 degrees, and by raising and lowering the antenna between 1 and 4 meters. Signal levels found were compared to an equivalent signal level of a generated carrier radiated from a dipole located at the EUT position.

No significant emissions were found aside from the transmitter fundamental and the second through the tenth harmonic. Other emissions that were seen were lower than 20 dB below the 90.210 limits. The unit was scanned for emissions while in continuous transmit, over the range 30 to 1800 MHz to establish compliance with Part 90 for the transmitter.

The required level for the transmitter harmonics and spurious signals where measured by means of a radiated measurement made in the FCC listed 3 meter semi-anechoic chamber, and is found by the substitution method, as described in EIA/TIA 603 section 2.2.12.2. i, j, k, and l. This method was used to confirm the calculated radiated signal level of a -20 dBm carrier, while transmitting into a reference dipole. By the mathematical method found in appendix A, a field strength of 75.23 dBuV/m is derived. Actual field measurements of this radiated field strength were performed using a set of reference dipoles, and a calibrated generator, on all of the harmonics from 300 mHz to 1 GHz. A comparison chart is given below. Because of the excellent correlation, the derived limit level was used for comparison of the signal levels for all the harmonics.

Frequency (MHz)	Reading(Vert) (dBuV/m)	Reading (Horiz) (dBuV/m)	Calculated level (dBuV/m)	Delta (Vert) (dB)	Delta (Horiz) (dB)
300	76.1	79.0	75.2	0.9	3.8
450	77.1	77.9	75.2	1.9	2.7
600	75.8	78.7	75.2	0.6	3.5
750	75.3	78.3	75.2	0.1	3.1
900	74.5	77.4	75.2	-0.7	2.2

1.6 Conducted Emission Tests:

The remaining Part 90 conducted tests, including spurious signals and modulation mask measurements were made via the antenna port of the surveillance transmitter. These tests were performed with a large 12 volt battery, and a regulating circuit to supply 9.4 VDC to the product, so that continuous tests could be run, without fear of excessive battery sag. Basic parameters were also verified with a terminal voltage of 8.7 volts, to determine whether weak batteries would have an adverse effect on product performance.

1.7 Power Output Test

For the 2.1046 measurement, the output of the EMIDS transceiver module was connected via a short jumper cable created for this measurement, into the input of the HP 8546A EMI receiver. The unit was configured to run in a continuous transmit mode, without modulation. The HP receiver was set to a 1 MHz Bandwidth, and the transmit signal was then measured, with the peak signal level stored. This power level was collected for a low and a high channel, and can be seen in the chart presented below.

CHANNEL	CENTER FREQ	NOMINAL	MEASURED POWER	DELTA
1	MHz	33 dBm	30.06 dBm	+.06 dB
41	MHz	33 dBm	30.04 dBm	+.04 dB

1.8 Conducted Spurious Emissions

For the 2.1051 measurement, the output of the EMIDS transceiver module was connected via a short jumper cable created for this measurement, through a fixed 10 dB pad, into the input of the HP 8546A EMI receiver. The unit was configured to run in a continuous transmit mode, without modulation. The HP receiver was set to a 10 kHz Bandwidth, and the transmitted spurious signals were then obtained. Frequencies from 30 MHz to 1600 MHz were inspected, with the fundamental (+62 to -62 kHz) excluded. The resultant levels and plots are found in appendix B and C. From this data, it can be seen that the EMIDS does **meet** the 2.1051 specification.

1.9 Occupied Bandwidth; Emission Mask requirements:

For the 2.1049 (90.210d) measurement, the output of the EMIDS transmitter module was connected via a short jumper cable created for this measurement, through a 10 dB pad, into the input of the HP 8546A EMI receiver. The unit was configured to run in a continuous transmit mode, both with and without modulation applied. The HP receiver was set to a 100 hertz Bandwidth, then several sweeps were made to develop the modulation characteristics. Two traces were generated and overlaid, one with no modulation applied to set a reference level, and then a second trace with modulation applied to develop the modulation characteristic. Plots were taken for two channels, one low and one high in the frequency range of the EMIDS transmitter. It can be seen from these plots that the EMIDS transmitter does **meet** the class D emission mask bandwidth requirement. The resultant plots are found in appendix C.

1.10 Transient Frequency Behavior:

For the 90.214 measurement, the output of the EMIDS transmitter module was connected via a short jumper cable created for this measurement, through an rf combiner network, and a 10 db pad, into the input of the HP 8555 Modulation domain Analyzer. A continuous signal set to the center of the channel frequency was coupled into the Modulation Domain Analyzer via the second input port on the RF combiner network. This signal was set to be 20 dB below the level of the transmitted signal of the EMIDS transmitter, and is used to allow the modulation analyzer to trigger cleanly on the short burst from the EMIDS. The EMIDS transmitter was then triggered manually via the infrared sensor, and the short burst of transmitted signal was then captured on the modulation analyzer. By inspection of the plots, the behavior of the transmitter at turn on and turn off can be observed. It can be seen that the frequency delta is below 6.25 kHz within 5 milliseconds of turn on, and since the transmitter output power is below 6 watts, the EMIDS **meets** the transient specification. The resultant plots are found in appendix C.

1.11 Stability, Frequency tolerance:

For the 2.995 (90.213a) Thermal stability measurement, the EMIDS transmitter was placed inside a Thermotron S-8C environmental chamber. DC power was fed in via a cable, and the RF output was routed outside the chamber, and connected through a 10 dB pad to a Spectrum analyzer. The EMIDS was powered on in continuous modulated transmit, and the signal was monitored during the test, whereby the temperature was varied in 10 degree steps from -30 Degrees to 50 degrees Centigrade. At each temperature plateau, the device was allowed to reach thermal equilibrium before the frequency was measured. As the observed frequency deviation is below the specification of 5 ppm, the EMIDS does **meet** the 90.213a specification.

Set temperature	Measure Temp	Freq. Measured (MHz)	Frequency deviation (hertz)	Ppm dev.
-30	-28.2	155.41545	+450	2.895
-20	-19.5	155.41550	+500	3.217
-10	-9.0	155.41545	+450	2.895
0	1.0	155.415425	+425	2.735
10	9.9	155.41535	+350	2.252
20	20.4	155.415325	+325	2.091
30	29.4	155.415225	+225	1.448
40	39.8	155.415225	+225	1.448
50	49	155.41515	+150	0.965

1.12 Modulation Characteristics.

The EMIDS transmitter has no provision for external modulation to be applied, and uses a fixed modulating frequency, and fixed deviation. These parameters are set at the manufacturer, and are not adjustable in the field. For this reason, no frequency response graphs were created, and overmodulation was ruled out by inspection of the 90.210d measurements. Refer to section 1.10 and the graphs in Appendix C for the supporting data.

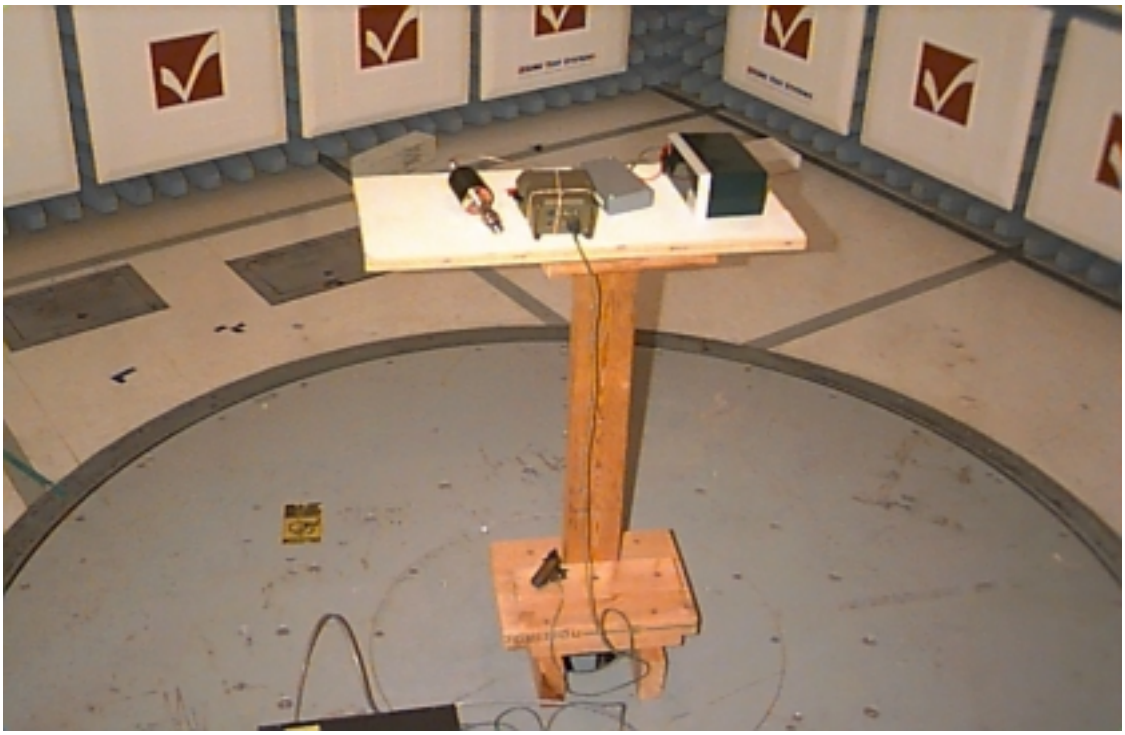
1.13 TEST EQUIPMENT UTILIZED FOR THE EMISSIONS TESTS

A list of the test equipment and antennas used for the tests can be found in Section 1.17, which includes the calibration information as well as the equipment description. All equipment is calibrated and used according to the user manuals supplied by the manufacturer. All antenna calibrations were performed at a N.I.S.T traceable site, and the resultant correction factors were entered into the Hewlett Packard 8546A EMI receiver software database. The connecting cables used, and attenuator pads, were also measured for loss using a calibrated signal generator and the HP 8546A EMI receiver. The resulting loss factors were entered into the HP 8546A database. This allowed for automatic changes in the antenna correction factor, as well as cable loss or other corrections, to be added to the EMI receiver display while taking measurements. Thus, the resulting data taken from the HP 8546A is an actual reading and can be entered into the database as a corrected meter reading.. The HP 8546A EMI receiver was operated with a bandwidth of 10 kHz when receiving signals below 1 GHz, and with a bandwidth of 1 MHz when receiving signals above 1 GHz, in accordance with TIA/EIA 603. Other IF and Video bandwidths, narrower than stated above, were used where appropriate and allowable.

1.14 PHOTOS TAKEN DURING TESTING

View of the EMIDS MMCT surveillance transmitter while performing transient Testing

View of the EMIDS MMCT surveillance transmitter while performing temperature/stability Testing



View of the EMIDS MMCT surveillance transmitter while performing Radiated Emissions Testing

View of the EMIDS MMCT surveillance transmitter while performing Conducted Emissions Testing

1.15 - Test Equipment

Asset #	Manufacturer	Model #	Serial #	Description	Due Date
AA960003	EMCO	3121C	786	Dipole Set Antenna	7/14/99
AA960004	EMCO	3146	9512-4276	Log Periodic Antenna	9/12/99
AA960005	EMCO	3110B	9601/2280	Biconical Antenna	9/12/99
AA960007	EMCO	3115	99111-4198	Double Ridged Guide/Horn Antenna	7/20/99
EE960004	EMCO	2090	9607-1164	Mast/Ttable Controller	I.O
EE960013	HP	8546A	3617A00320	Receiver RF Section W/Display and RF filter section	8/12/99
CC000124(	HP	53310A	3121A01379	Modulation Domain Analyzer	I.O.
CC000130	HP	8596E	3205A00103	Spectrum Analyzer	8/12/99
EE960014	HP	85460A	3448A00296	Receiver RF Section Preselector	8/12/99

1.16 conclusion

The Qual-tron EMIDS MMCT surveillance transmitter was found to **meet** all of the parameters needed to obtain certification for a transmitter in the public radio service, as a 2 watt or less portable unit.

APPENDIX A:

SAMPLE CALCULATIONS

FIELD STRENGTH OF FUNDAMENTAL FREQUENCIES:

Conducted: Measured at 30.0 dBm for the one watt power level.

FIELD STRENGTH OF SPURIOUS/HARMONIC FREQUENCIES:

All out of band spurious emissions must be below the mean power of the carrier by at least:

50 + 10 log(carrier power)

which for the 1 watt rating on the test sample is:

50+ 10 log(1)
50 – 0 = 50 dBc,
which is the level below the mean carrier for spurs/harmonics

-50 dBc from 30.0 dBm = -20.0 dBm

FIELD STRENGTH OF PART 90 LIMIT: AT R = 3 METERS DSTANCE

FROM THE STANDARD REFERENCE FORMULA FOR POWER TRANSMITTED VERSUS ELECTRIC FIELD:

$Pt = (R^{**}) \times |E|^{**} / 30$

Then to convert to dB:

$Pt = 20\log|E| + 20\log(R) - 10\log(30)$

Insert additional terms to convert watts to milli-watts (in dB) and volts to micro-volts (in dBuV):

$Pt = 20\log|Euv| - 20\log(1{,}000{,}000) + 10\log(1000) + 20\log(3) - 10\log(30)$

$Pt = 20\log|Euv| - 120 + 30 + 9.54 - 14.77$

$Pt = 20\log|Euv| - 95.23$

OR; $20\log|Euv| = Pt \text{ (in dBm)} + 95.23$

$|E|$ (in dBuV) = -20 dBm + 95.23 = 75.23 dBuV/m , at 3 meters

APPENDIX B:

DATA CHARTS

FCC ID: OGE-QTI-EMIDS

RADIATED EMISSIONS IN THE 3 METER FCC LISTED CHAMBER

Date of Test:	13 April, 18.19 May, 1999	Manufacturer:	Qual-Tron
Location:	L. S. Compliance, Inc.	Model No.:	EMIDS MMCT
	W66 N220 Commerce Court		
	Cedarburg, WI 53012		
Specifications:	90.210	Serial No.:	preproduction
Equipment:	HP 8546A EMI Receiver	Configuration:	Continuous transmit at 154.7 MHz
	EMCO 3110B biconical	Detector(s) Used:	Peak (with 10 kHz RBW) below 1 GHz
	EMCO 3146A Log Periodic		Average (with1 MHz RBW) above 1 GHz
	EMCO 3115 Waveguide Horn		Ch 01

FREQ (MHz)	ELEV. (meters)	AZIMU (degrees)	POL. (H/V)	ORIENT. (position)	METER (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)
309.3	1.0	120	H	flat	63.2	75.2	12.0
773.3	1.1	80	H		57.8	75.2	17.4
1082.7	1.45	100	H		58.6	75.2	16.6
1237.3	1.25	85	H		58.3	75.2	16.9
1392.0	1.15	25	H		64.4	75.2	10.8
1546.7	1.05	65	H		72.2	75.2	3.0
309.3	1.05	290	V		61.9	75.2	13.3
618.7	1.0	150	V		56.4	75.2	18.8
773.3	1.0	105	V		59.5	75.2	15.7
1391	1.8	160	V		67.7	75.2	7.5
1546	1.17	165	V		72.7	75.2	2.5

FCC ID: OGE-QTI-EMIDS

RADIATED EMISSIONS IN THE 3 METER FCC LISTED CHAMBER

Date of Test:	13 april, 18,19 May, 1999	Manufacturer:	Qual-Tron
Location:	L. S. Compliance, Inc.	Model No.:	EMIDS MMCT
	W66 N220 Commerce Court		
	Cedarburg, WI 53012		
Specifications:	90.210	Serial No.:	preprodution
Equipment:	HP 8546A EMI Receiver	Configuration:	Continuous transmit at 155.7 MHz
	EMCO 3110B biconical	Detector(s) Used:	Peak (with 10 kHz RBW) below 1 GHz
	EMCO 3146A Log Periodic		Average (w/1 MHz RBW) above 1 GHz
	EMCO 3115 Waveguide Horn		Ch 41

FREQ (MHz)	ELEV. (meters)	AZIMU (degrees)	POL. (H/V)	ORIENT. (position)	METER (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)
311.4	1.0	120	H	flat	63.5	75.2	11.7
778.6	1.1	80	H		58.0	75.2	17.2
1090.0	1.45	95	H		58.9	75.2	16.3
1245.7	1.25	80	H		57.9	75.2	17.3
1401.5	1.0	50	H		67.2	75.2	8.0
1557.1	1.4	50	H		66.8	75.2	8.4
311.4	1.0	300	V		62.0	75.2	13.2
622.9	1.0	150	V		56.0	75.2	19.2
778.6	1.0	100	V		59.5	75.2	15.7
1090.0	1.0	05	V		58.1	75.2	17.1
1245.75	1.4	165	V		56.8	75.2	18.4
1401.5	1.1	170	V		71.3	75.2	3.9
1557.2	1.15	320	V		65.4	75.2	9.8

**All other harmonics and spurs were greater than dB below the limit

FCC ID: OGE-QTI-EMIDS
CONDUCTED EMISSIONS IN THE 3 METER FCC LISTED CHAMBER

Date of Test:	15 March, 1999	Manufacturer:	Qual-Tron
Location:	L. S. Compliance, Inc.	Model No.:	EMIDS
	W66 N220 Commerce Court		
	Cedarburg, WI 53012		
Specifications	90.210	Serial No.:	preprodution
Equipment:	HP 8546A EMI Receiver	Configuration:	Continuous transmit at channels 01, 41 154.7, and 155.7 MHz
	EMCO 3110B biconical	Detector(s) Used:	Peak (with 10 kHz RBW) below 1 GHz
	EMCO 3146A Log Periodic		Average (w/1 MHz RBW) above 1 GHz
	EMCO 3115 Waveguide Horn		

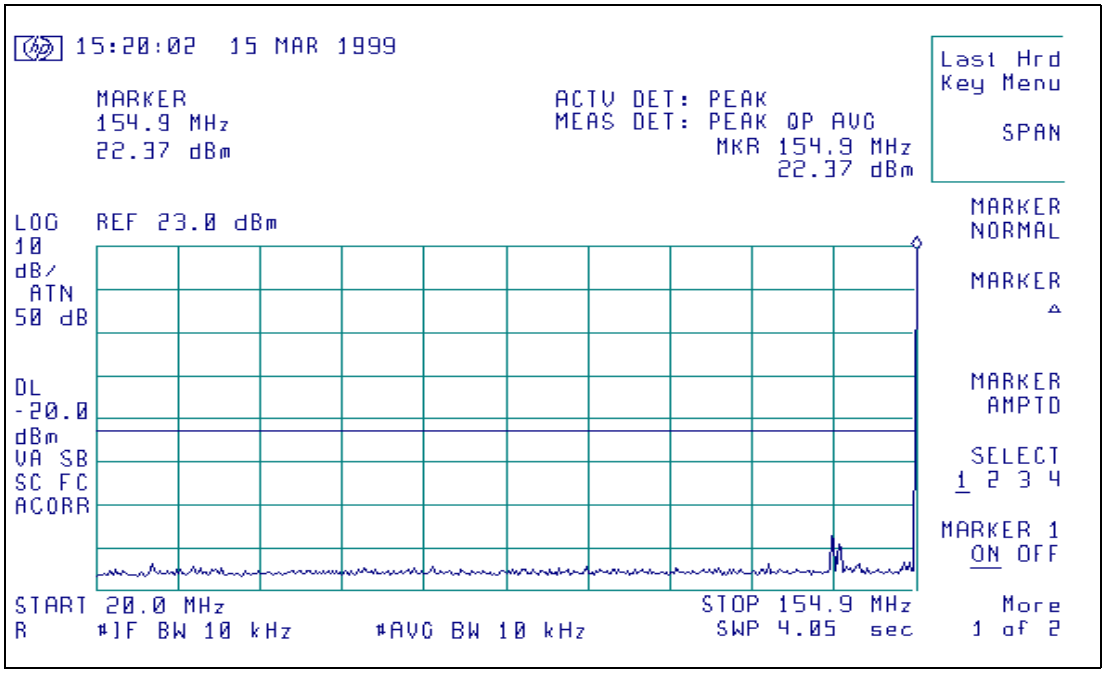
Frequency (MHz)	EMI Reading (dBm)	Channel Number	Limit	margin
1388.5	-32.5	01	-20.0	12.5
310.7	-43.1	01	-20.0	23.1
1231.0	-33.4	41	-20.0	13.4
312.7	-42.9	41	-20.0	22.9

APPENDIX C:

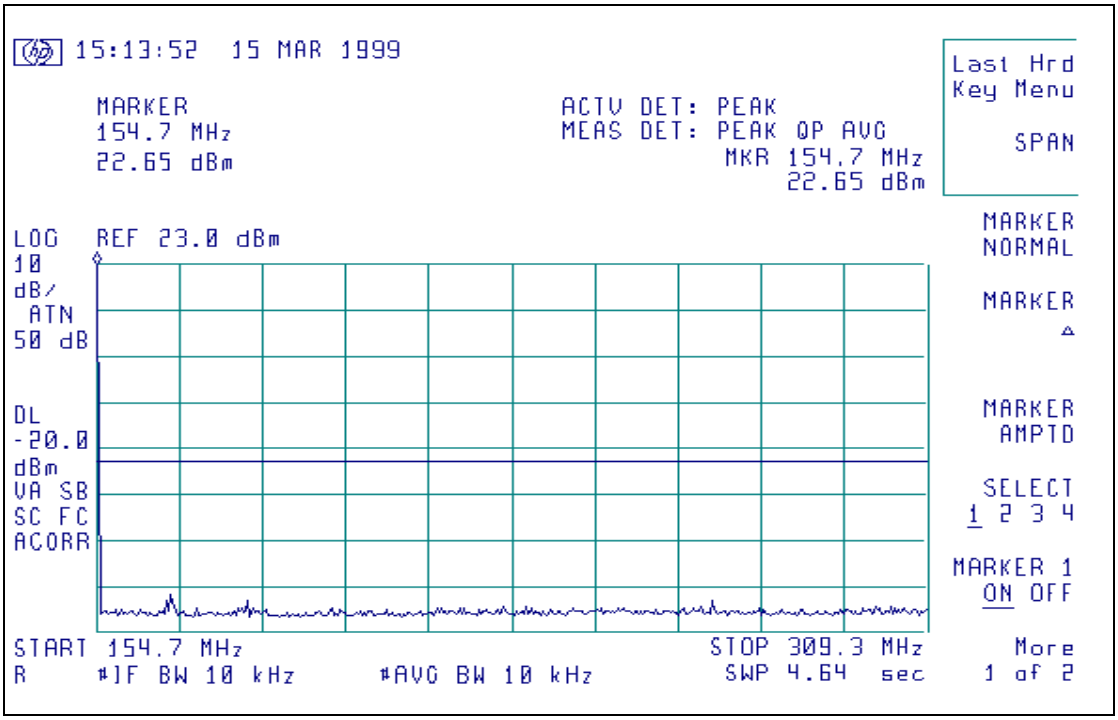
GRAPHS

CONDUCTED EMISSIONS IN THE 3 METER FCC LISTED CHAMBER

Channel 01



Channel 01



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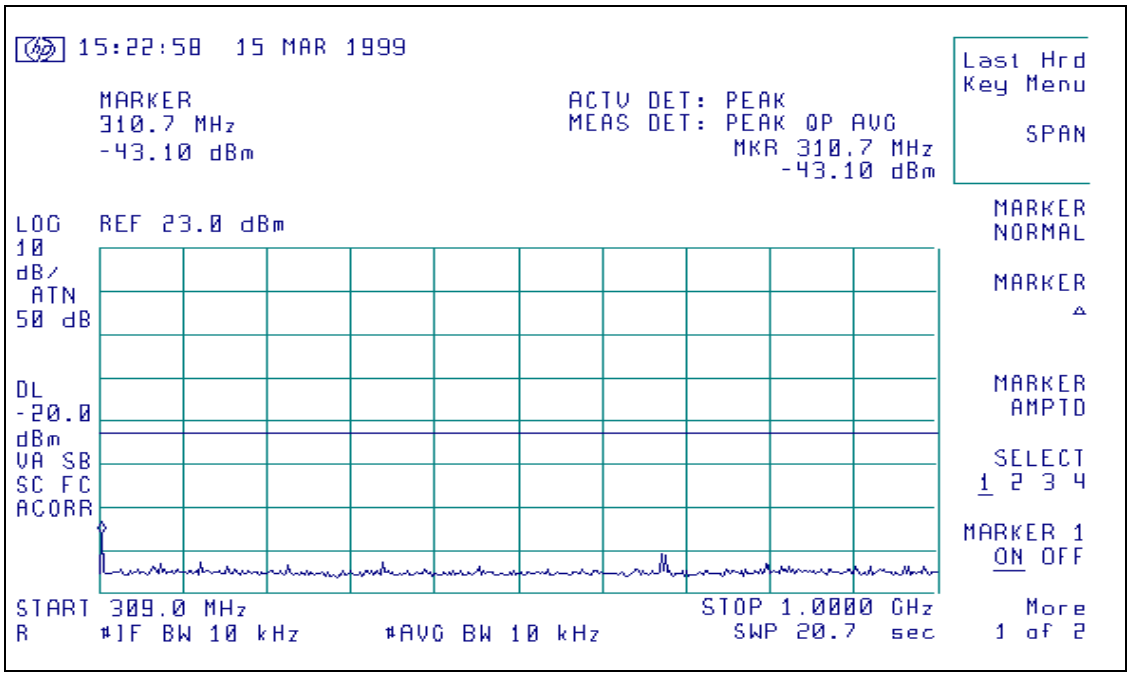

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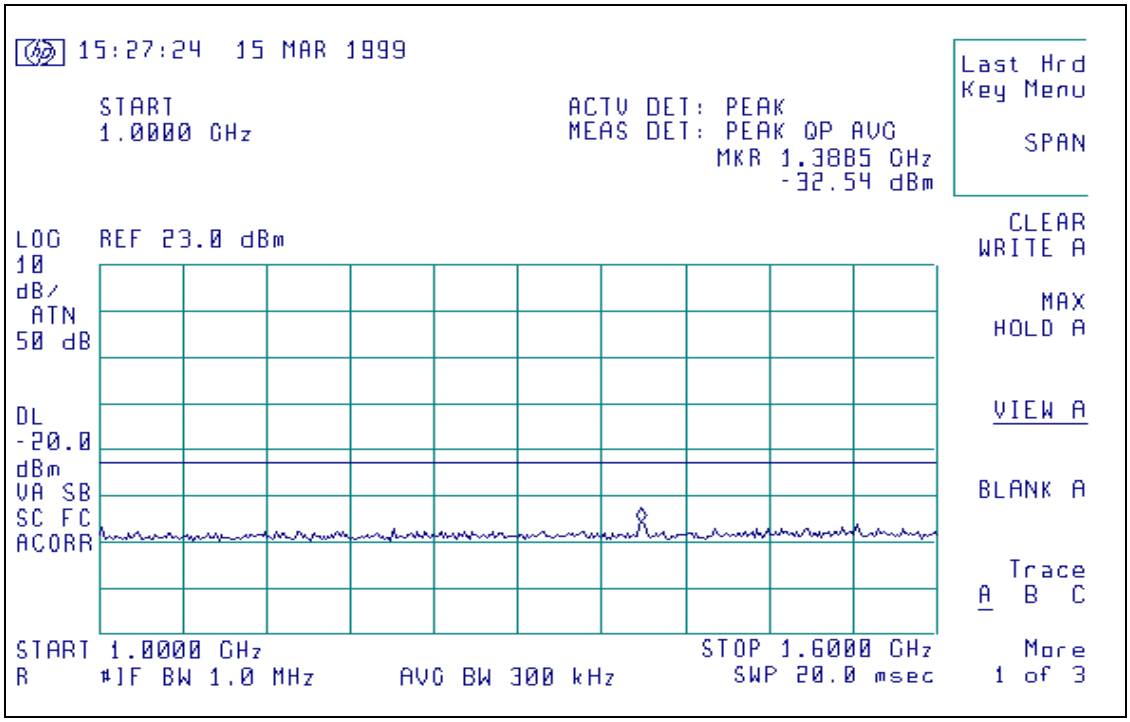
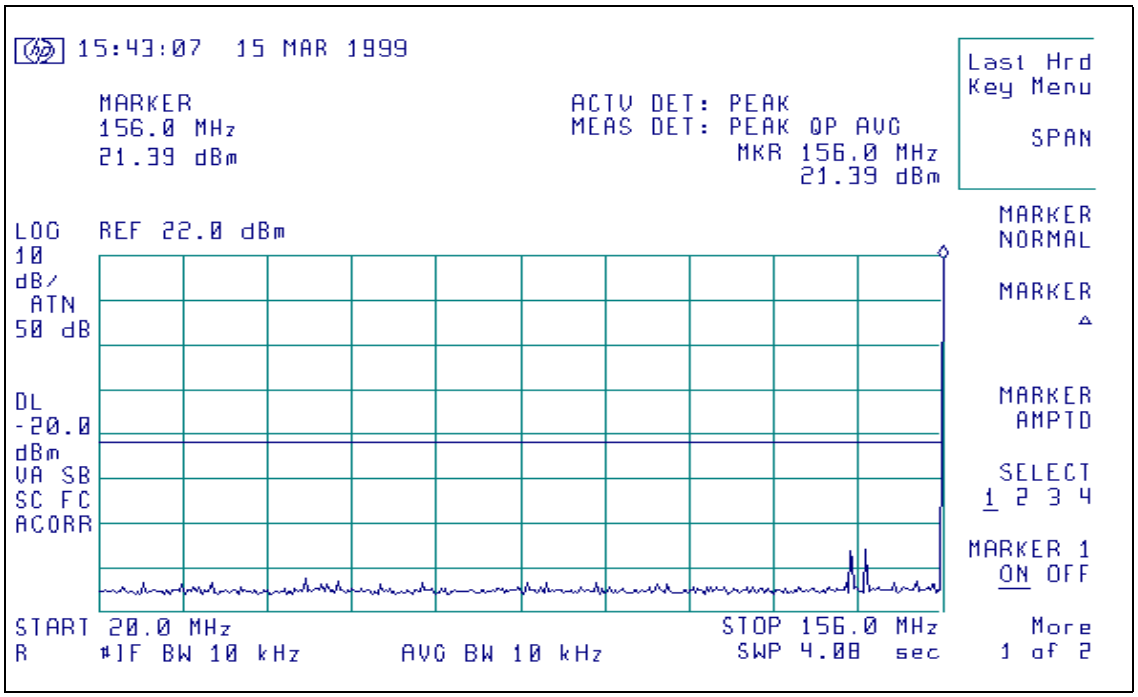


CONDUCTED EMISSIONS IN THE 3 METER FCC LISTED CHAMBER

Channel 41



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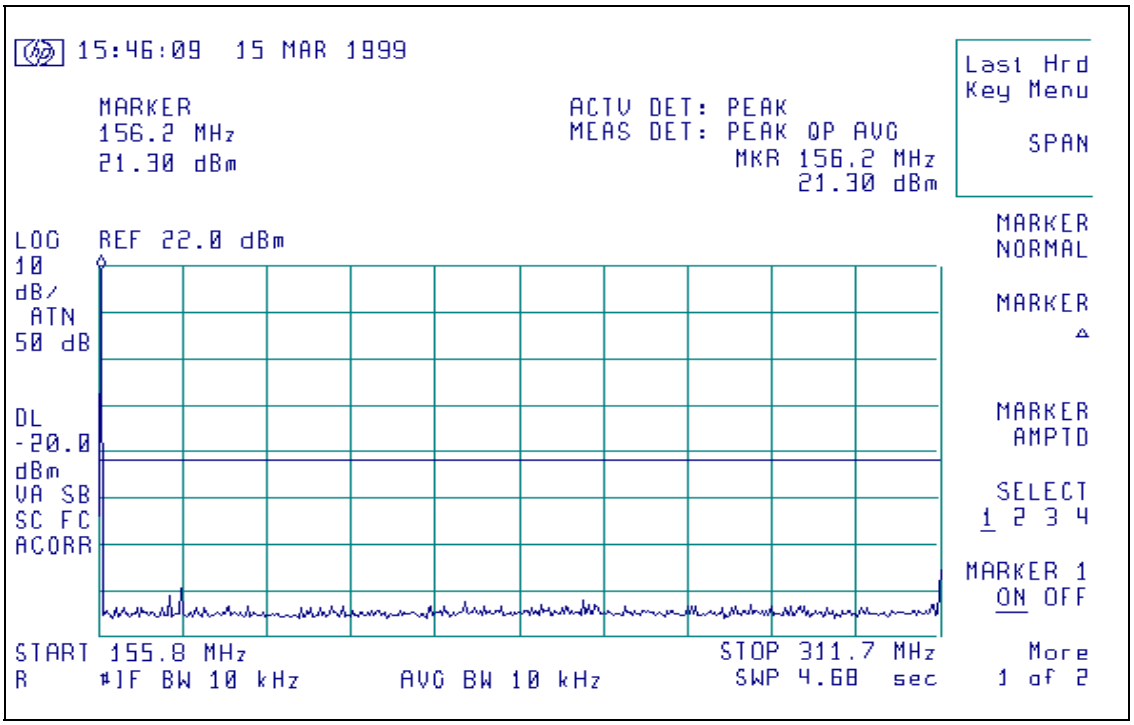

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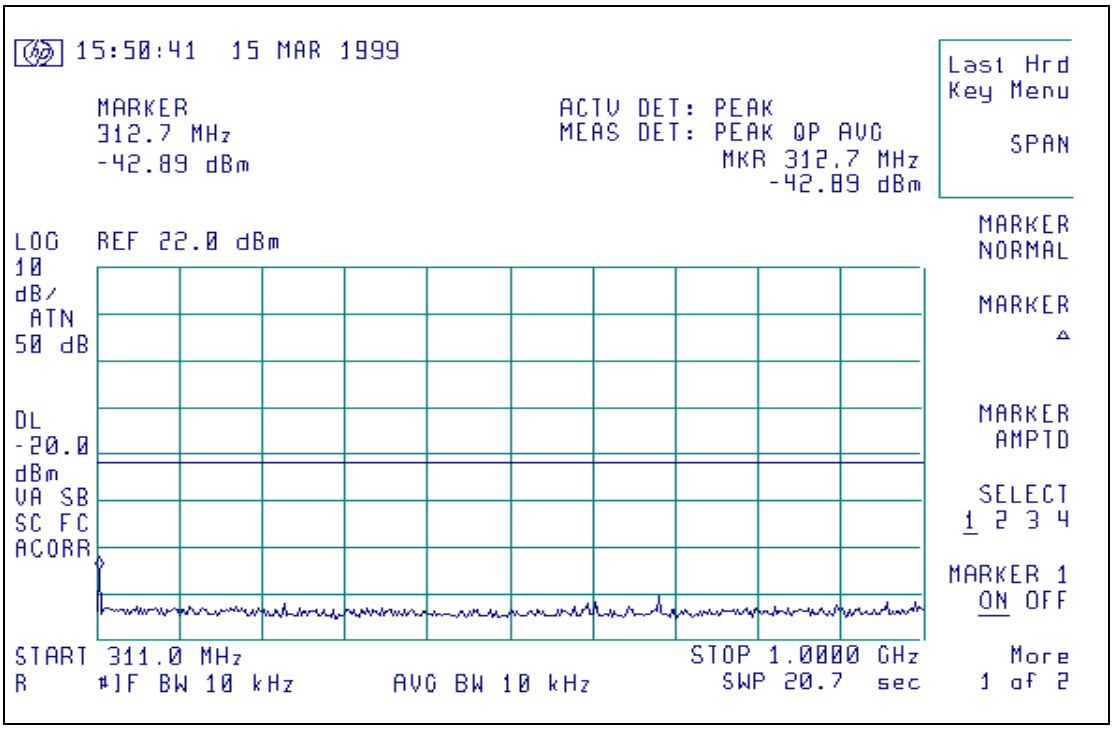

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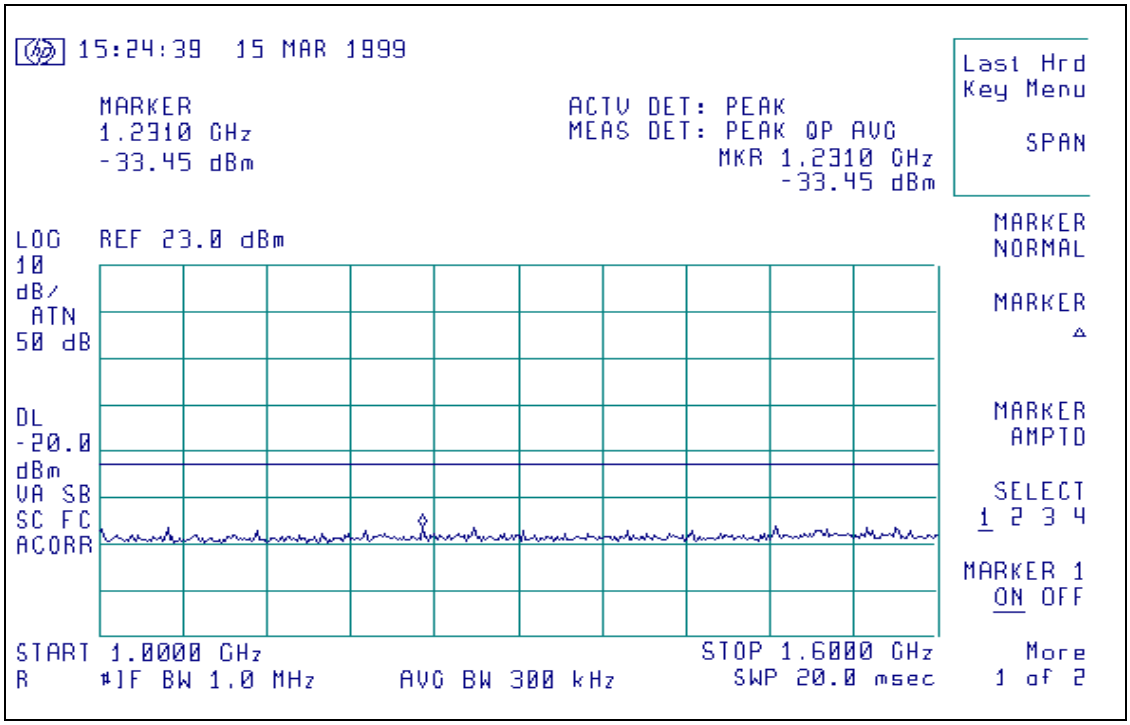

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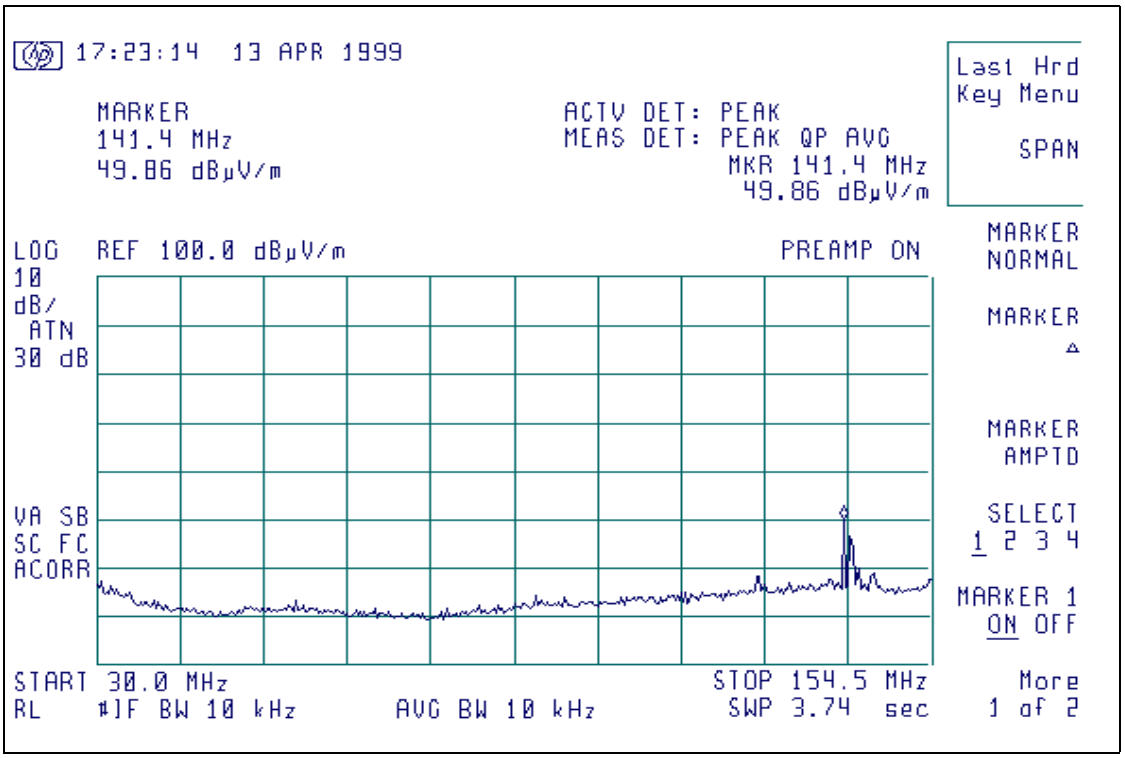

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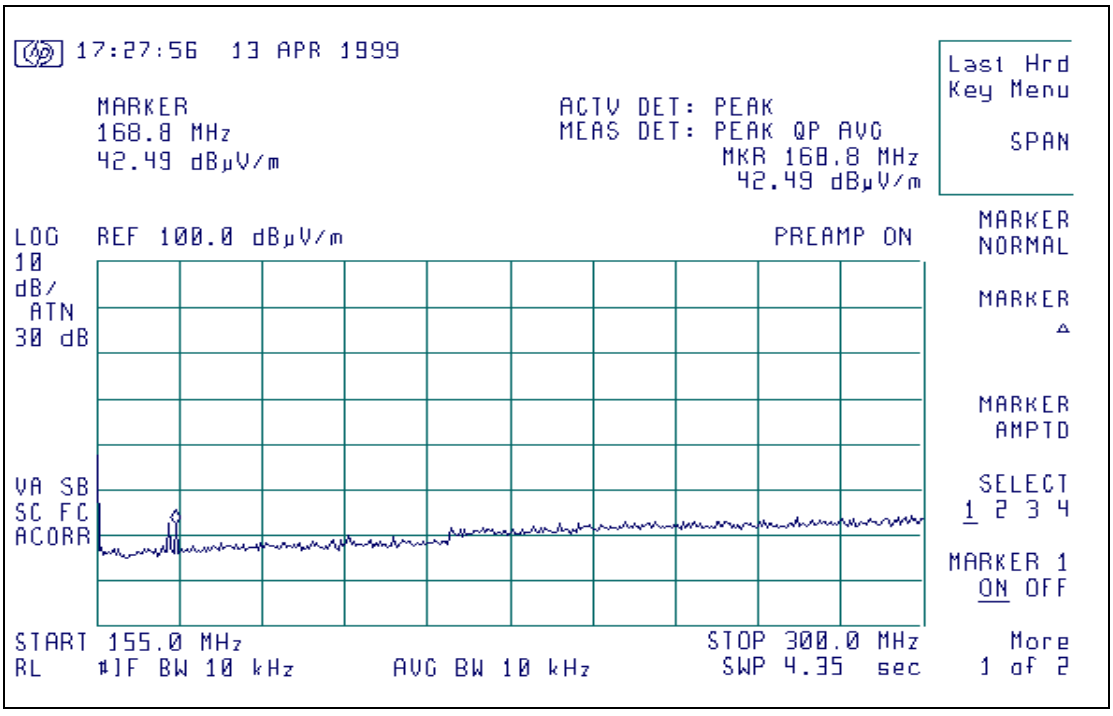

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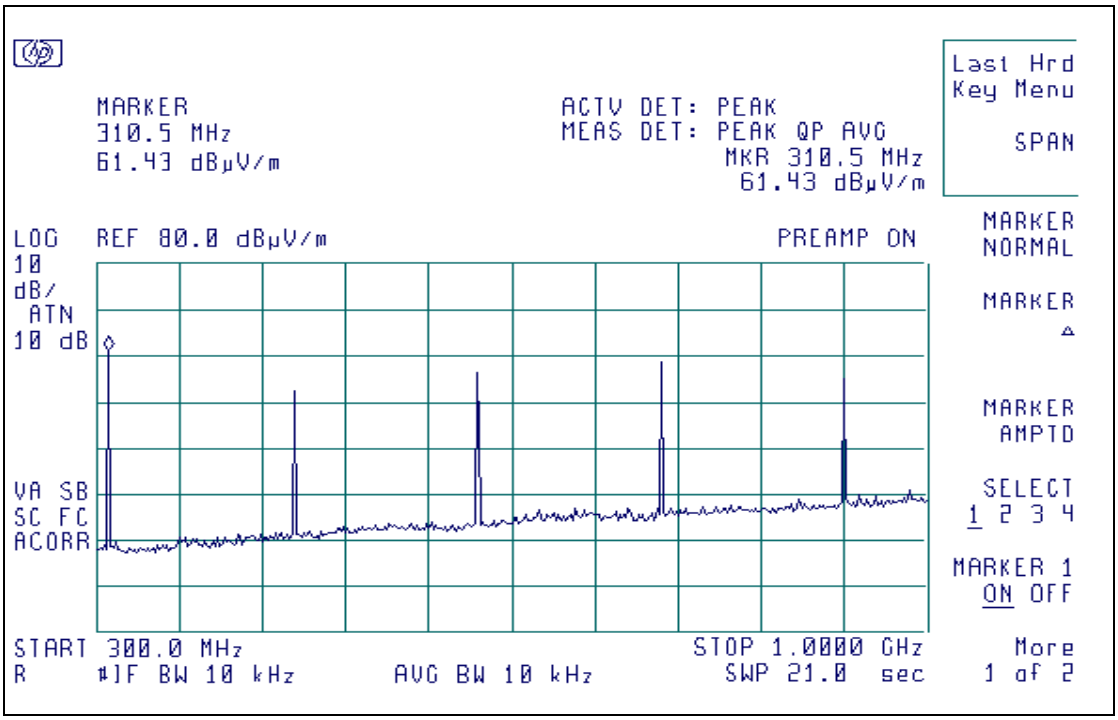

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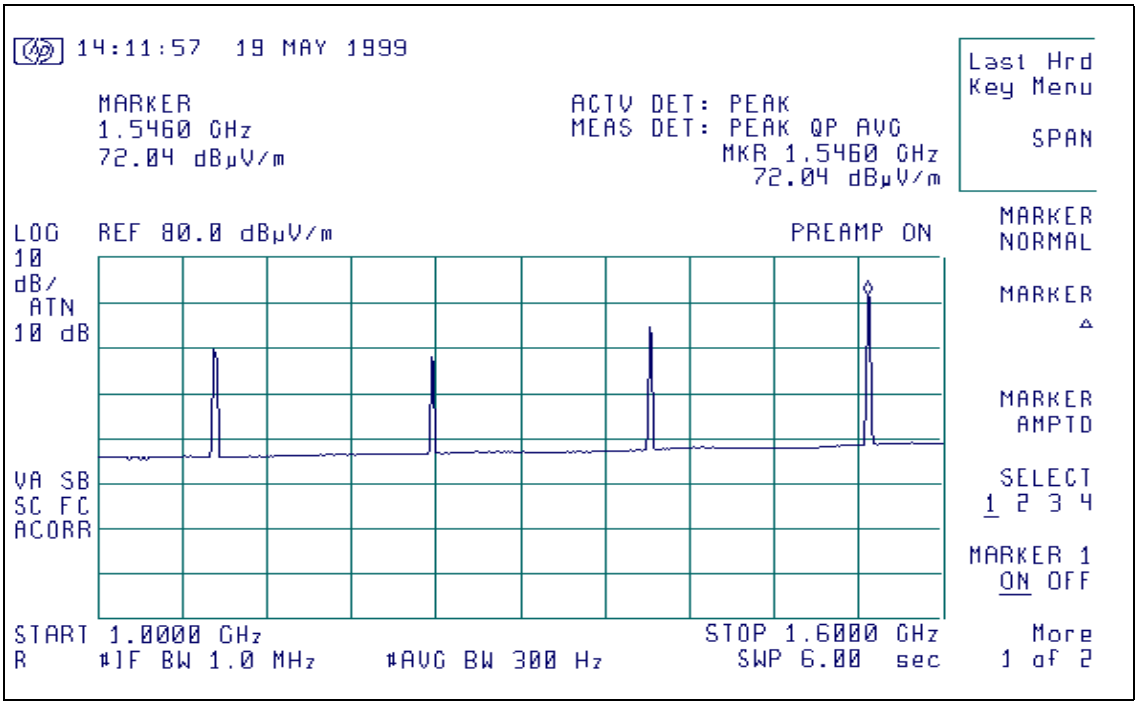

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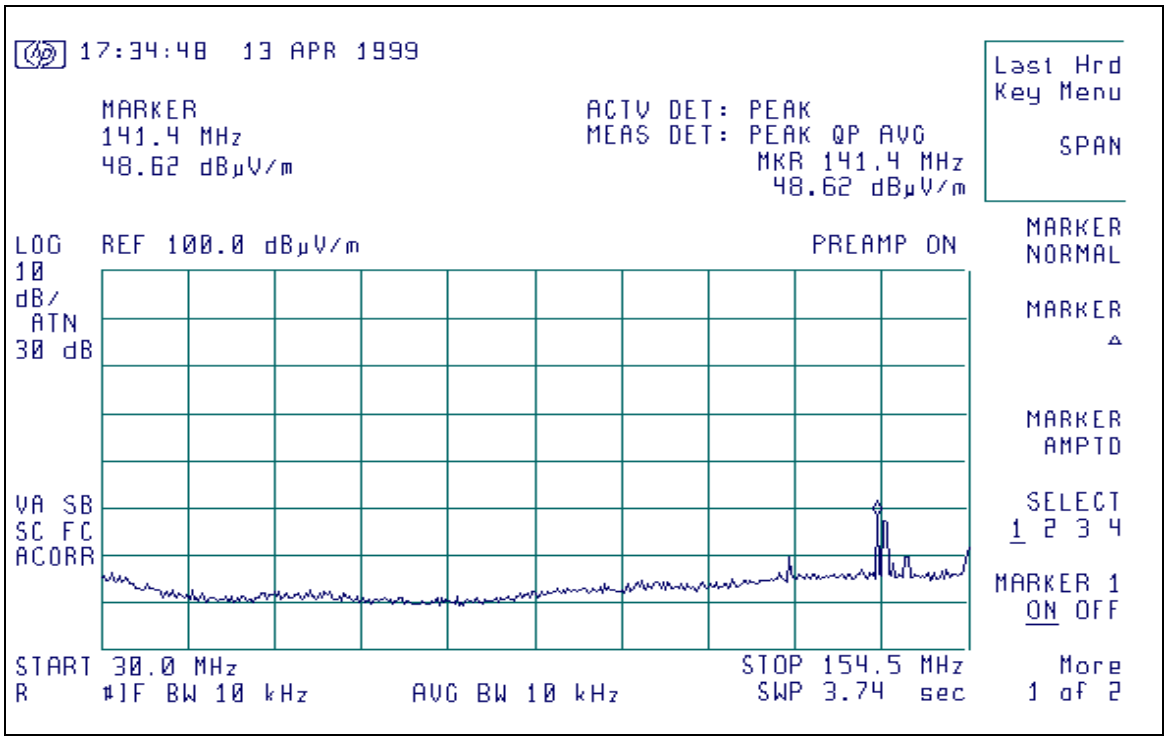

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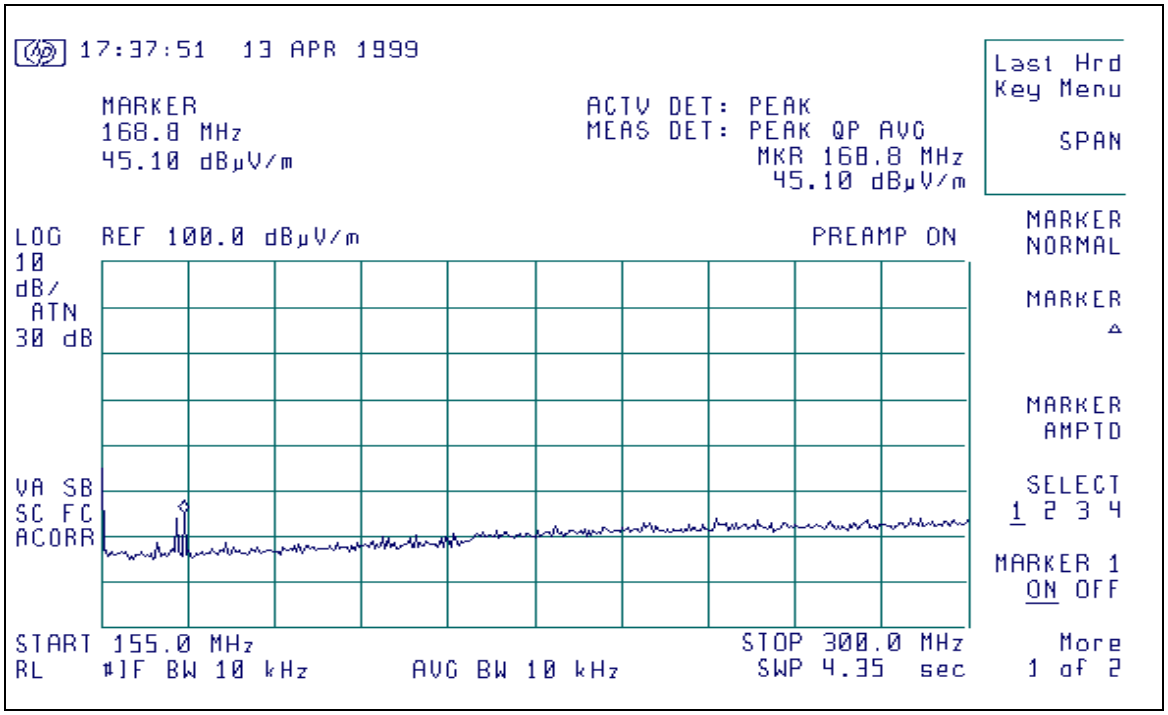
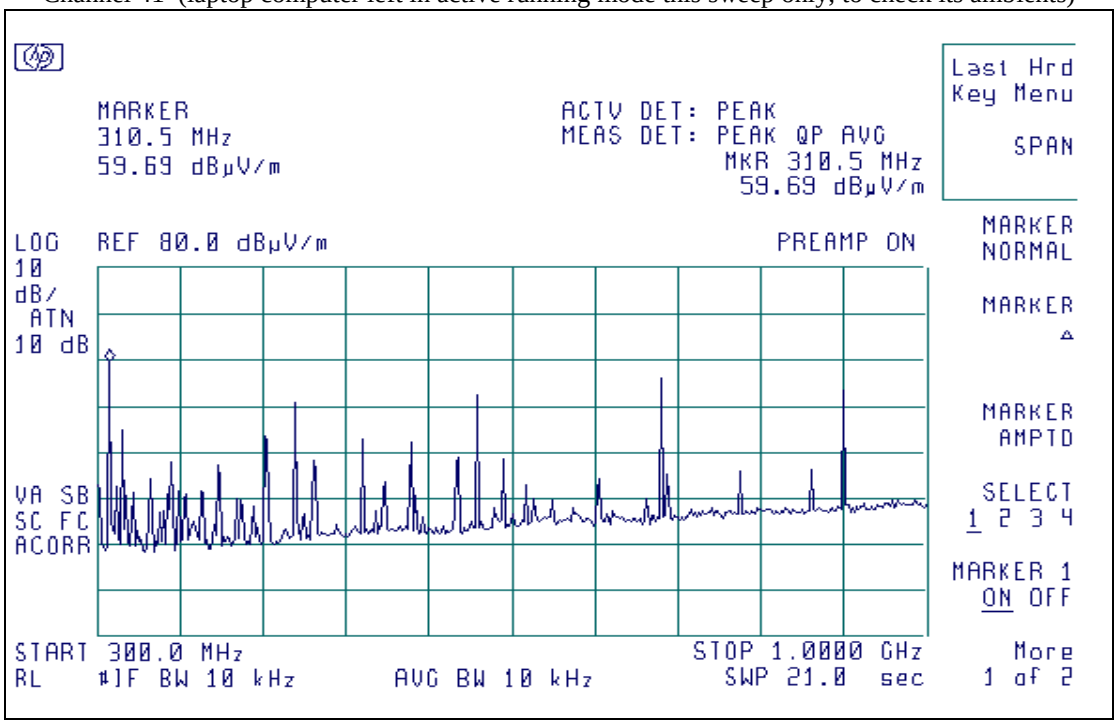
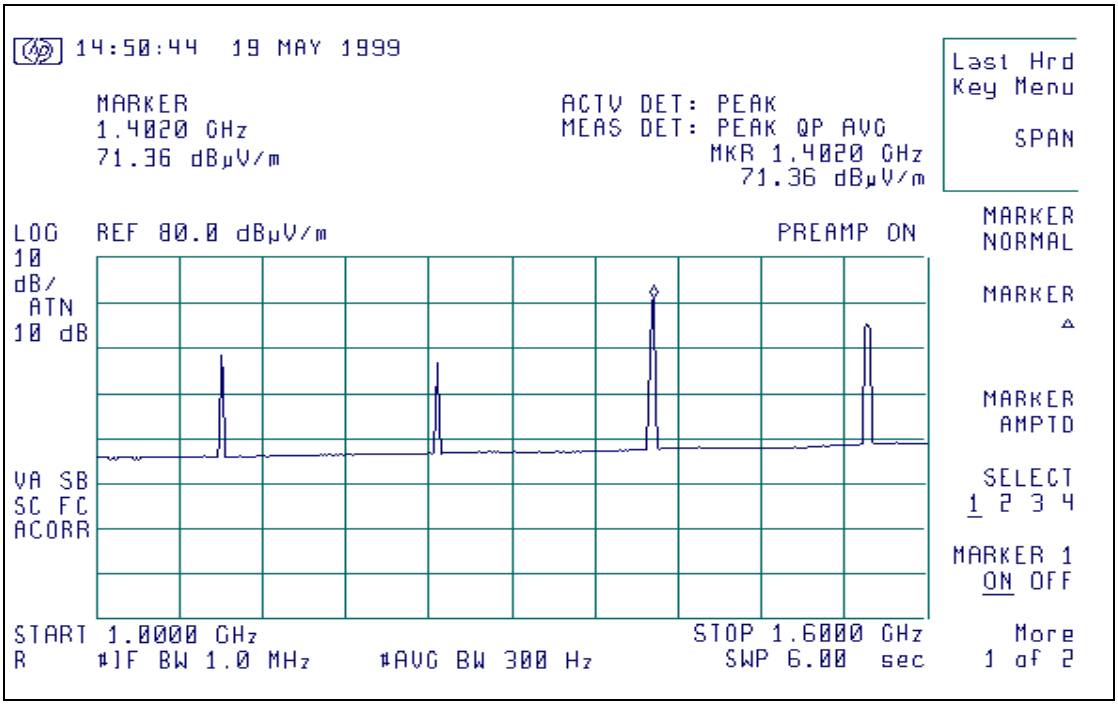


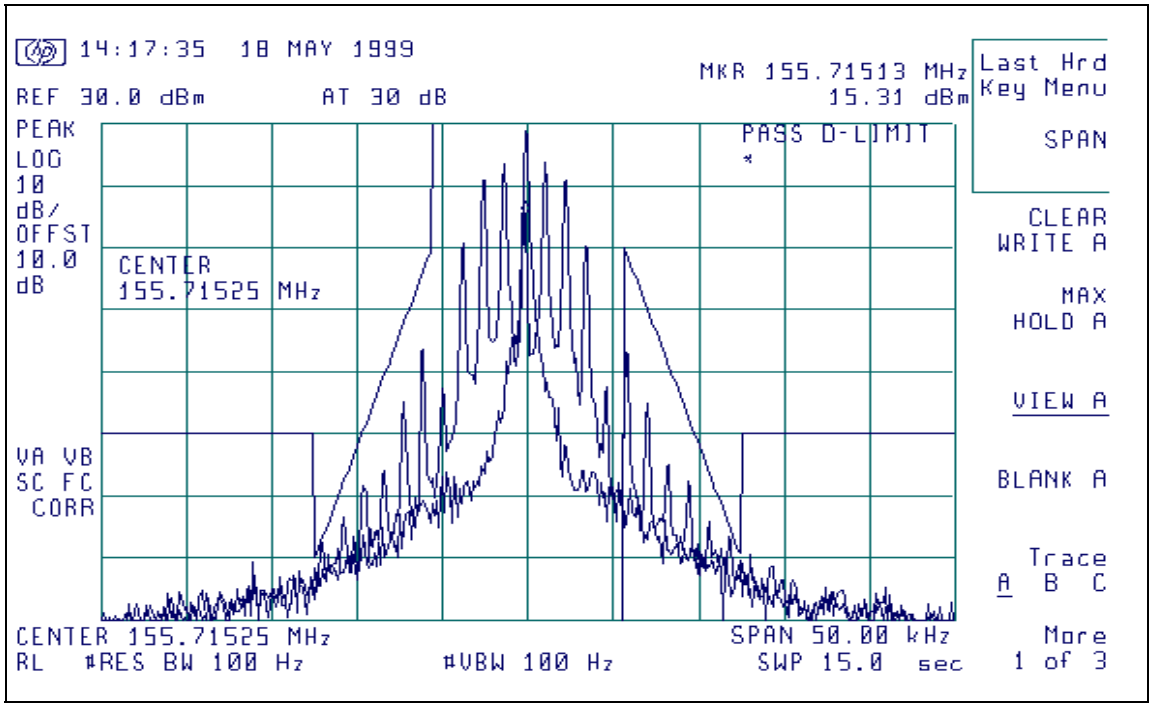
Channel 41 (laptop computer left in active running mode this sweep only, to check its ambients)



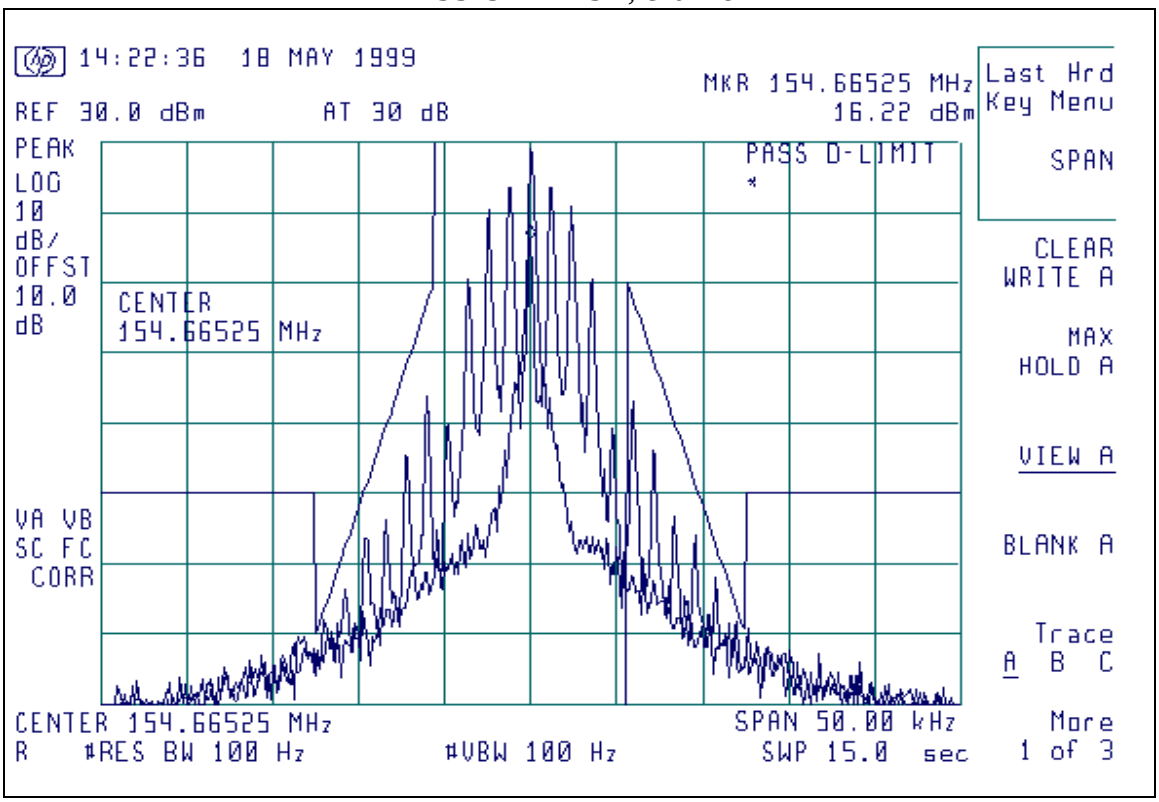
Channel 41



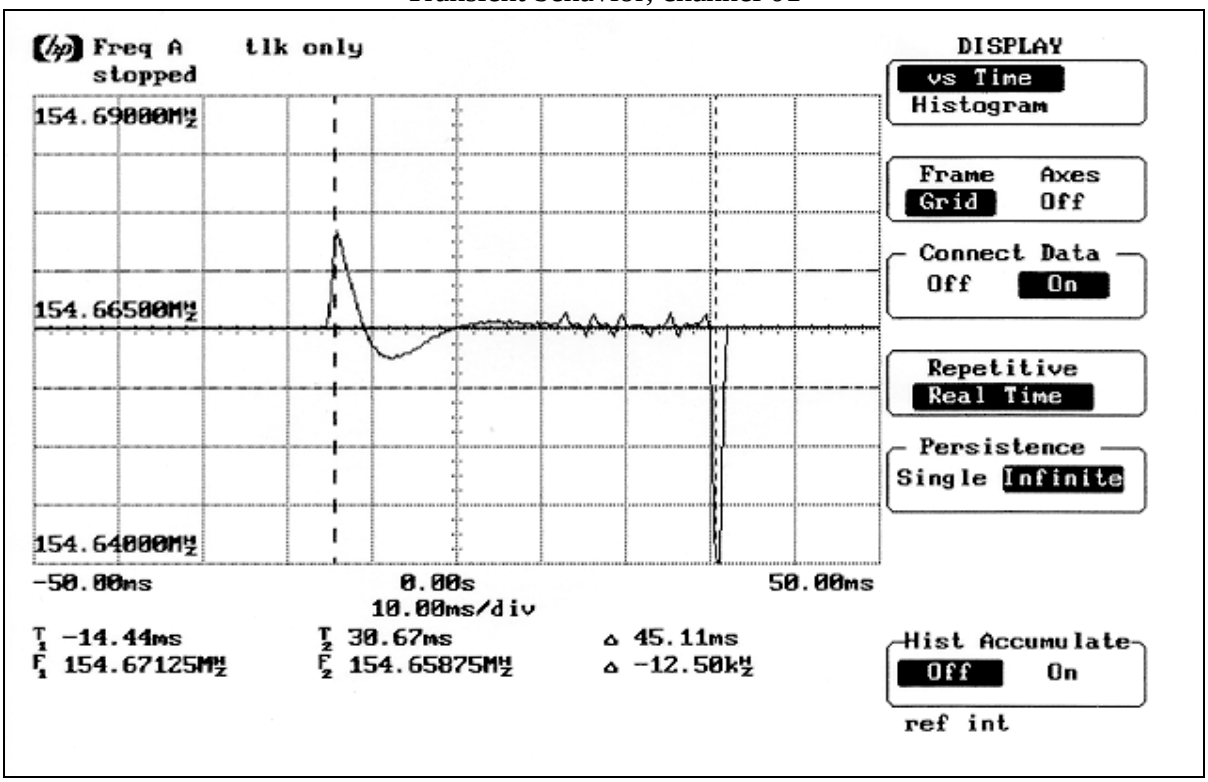
EMISSION MASK DETAIL, channel 01



EMISSION MASK, channel 41



Transient behavior, channel 01



Transient behavior, channel 41